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INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF OUTER SPACE: ACTIVITIES OF MEMBER STATES

Note by the Secretariat

Addendum

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INTRODUCTION

1. Documents A/AC.105/567 and A/AC.105/567/Add.1 contain information received from Member States as of 15 December 1993 on the following topics, pursuant to a recommendation made by the Committee on the Peaceful Uses of Outer Space at its thirty-sixth session:[1]

(a) Those space activities that were or could be the subject of greater international cooperation, with particular emphasis on the needs of the developing countries;

(b) Spin-off benefits of space activities.

2. The present document contains information on those topics that was received from Member States from 7 to 15 February 1994.

[1]Official Records of the General Assembly, Forty-eighth Session, Supplement No. 20 (A/48/20), para. 122.

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REPLIES RECEIVED FROM MEMBER STATES*

SWEDEN

[Original: English]

Swedish National Space Board

SPACE ACTIVITIES IN SWEDEN

1. NATIONAL ORGANIZATION OF SPACE ACTIVITIES

1.1 The Swedish National Space Board (SNSB)

The Swedish National Space Board, under the Ministry Industry and Commerce, is the central governmental agency responsible for the Swedish national and international space and remote sensing programmes. The Board receives funds for the research programme from the Ministry of Education and Science.

The responsibilities of the Board include:

- initiating research, development and other activities connected with the Swedish space and remote sensing programme;
- coordinating Swedish activities within the fields of space technology and research as well as remote sensing;
- distributing government appropriations for Swedish space activities;
- authorizing and supervising space activities in accordance with space law;
- maintaining contacts with international organizations and institutions operating within the field of space activities and remote sensing.

The Board has three advisory committees: for industrial policy, science (incl. microgravity) and remote sensing respectively.

The technical implementation of the national space remote sensing programmes are mainly contracted by the Board on an annual basis to the state owned Swedish Space Corporation (SSC).

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*The replies are reproduced in the form in which they were received.

1.2 The Swedish Space Corporation (SSC)

In addition to performing its tasks for the Board, the Swedish Space Corporation is now active in a number of areas related to space technology and remote sensing It is organized in five divisions with the following main activities:

- Esrange Division; sounding rocket and balloon launchings, scientific satellite support;
- Earth Observation Division; satellite tracking, telemetry and command (TT&C) services, data acquisition, archiving and processing of data from Earth observation satellites, production and marketing of satellite data and enhanced products;
- Science Systems Division; design and project management for space science research satellites, development of sounding rocket and balloon payloads, supply of microgravity services;
- Telecom Division; television broadcasting, business television, data communication services, contribution and news gathering;
- Strategy Division; assistance to SNSB and other domestic and international government agencies, systems and methodology development within Earth observation, development and marketing of airborne systems for maritime surveillance and environmental control.

The Swedish Space Corporation has three establishments, two in Kiruna (Esrange and Satellitbild) and one in Stockholm (headquarters).

2. MANNED SPACEFLIGHTS

Sweden participates in manned space activities within the European Space Agency (ESA). One of the astronauts in the European Astronaut Corps is a Swede.

3. SPACE APPLICATIONS PROGRAMMES

3.1 Remote sensing of Earth resources and environment

The past years have been characterized by development and consolidation of remote sensing activities in Sweden. New advanced equipment has been made available through local development, through purchase, or through international cooperation. Several major cooperative field experiments have been carried out. The objective is to assess the potential of the technology for various applications, but above all to acquaint the potential users with the available technology at an early stage.

In 1992 Sweden contributed to the International Space Year project, "World Forest Watch".

The Esrange facility, which has been receiving and processing Landsat data on behalf of ESA since 1978, receives SPOT data on behalf of the Centre National d'Etudes Spatiales (CNES), France. Data is also regularly received from the polar orbiting satellites Japanese Earth Resource Satellite (JERS-1) and Marine Observation Satellite (MOS) (Japan), and on an experimental basis data has been received from Resurs and Okean (Russian Federation). There is an agreement with ESA to receive and process European Remote Sensing Satellite (ERS-1) data. A separate ESA facility has been established for that purpose at Salmijärvi (near Esrange).

SSC Satellitbild in Kiruna processes and distributes SPOT data in cooperation with the French company SPOT Image. SSC Satellitbild specializes in providing geometrically precision corrected SPOT and Landsat data for the world market.

Sweden cooperates with France in the SPOT remote sensing satellite programme, and the Kiruna facility is one of the two principal stations in the SPOT network.

Sweden takes part in the ESA programme for receiving, preprocessing, archiving and distributing images from remote sensing satellites (Earthnet). The Swedish ground station at Esrange, Kiruna, forms part of the system and is collecting Landsat data on a routine basis. The Swedish Space Corporation is the National Point of Contact (NPOC).

Sweden also takes part in the remote sensing programmes of ESA such as the programme for development of remote sensing satellites (ERS-2 and Envisat-1), the Earth observation preparatory programme (EOPP) and the Polar Platform.

The Swedish Space Corporation, in cooperation with the Swedish National Environmental Protection Agency and the local authorities, is in the process of establishing a Centre for Environmental Data from Satellites in Kiruna. The primary tasks of the Centre will be production and management of environmental data bases. It will also develop new databases and conduct environmental surveillance activities.

3.2 Meteorology

Cloud cover photographs and other meteorological data from ESA, United States and Russian Federation weather satellites are received regularly by the High-Resolution Picture Transmission (HRPT) and Automatic Picture Transmission (APT) stations of the Swedish Weather Services and are used in weather forecasting.

A project concerning the establishment of short-term weather forecasting and regional weather service based on advanced space and remote sensing techniques, including weather radar, sonic radar (SODAR), microwave radiometry and weather satellites, has entered into an operational phase.

Development of the operational use of advanced digital image analysis of polar weather satellite data is continuing. A microwave radiometer for sounding of atmospheric temperature and humidity has been developed for operational use.

Sweden takes part in the ESA Metop preparatory programme.

3.3 Communications

Sweden participates in the telecommunications programmes of ESA such as the programmes for Advanced Research in Telecommunications Systems (ARTES), the technology demonstration mission (TM) and data relay satellites (DRS).

On a national level, the Swedish Space Corporation operates the Tele-X telecommunications satellite system. Tele-X provides the following services:

(a) High-speed digital data and video communications, 64 kbit/s - 2 Mbit/s, using small earth stations.

(b) Direct TV-broadcasting to small (30 cm diameter) home receivers.

3.4 Navigation

Satellite navigation equipment is in routine use on Swedish merchant vessels using Transit/Navstar-type satellites.

Sweden (SSC) is active in the development of Global Positioning System (GPS) technology for aeronautical, maritime and landmobile applications, using the Swedish Global Positioning and Communication (GP&C) invention. This invention makes possible the location of several thousand mobiles on a single radio channel.

4. NATIONAL SCIENTIFIC SPACE PROGRAMMES

The scientific activities of Swedish research groups are mainly:

- Magnetospheric and ionospheric physics, in particular measurements of charged particles and electric and magnetic fields using satellite experiments, sounding rockets and balloons.

  Groups: Swedish Institute of Space Physics, Kiruna

  Swedish Institute of Space Physics, Uppsala

  Dept. of Plasma Physics of the Alfvén Laboratory,
  Royal Institute of Technology, Stockholm

- Study of the upper atmosphere, (80-150 km) in particular atmospheric processes and composition at high latitudes using sounding rockets.

  Group: Inst. of Meteorology, Stockholm University

- Astrophysics in particular studies of solar and stellar UV radiation and IR and sub-millimetre studies using satellites, sounding rockets and balloons in international cooperation.

  Groups: Lund Observatory, University of Lund

  Stockholm Observatory, Stockholm University

  Uppsala Astronomical Observatory, University of Uppsala

  Onsala Space Observatory,
  Chalmers University of Technology, Gothenburg

- Materials sciences, in particular solidification processes of metals, diffusion processes in liquid metals and crystal growth in microgravity using sounding rockets.

  Groups: Dept. of Casting of Metals,
  The Royal Institute of Technology, Stockholm

  University of Sundsvall

- Life sciences, in particular studies of human physiological processes in microgravity.

Group: Environmental Physiology Laboratory, Karolinska Institutet, Stockholm

- Biophysics, in particular electrophoretic and protein crystal growth studies in microgravity.

Group: Dept. of Physical and Inorganic Chemistry,
Chalmers University of Technology, Göteborg

- Remote sensing, in particular microwave radiometry, spectral signatures and image analysis using satellite data or data registered by airborne or land-based sensors.

Groups: Dept. of Radio and Space Science,
Chalmers University of Technology, Gothenburg

Remote Sensing Laboratory,
Dept. of Physical Geography, Stockholm University

Remote Sensing Laboratory,
Dept. of Physical Geography, University of Lund

Dept. of Physics, Lund Institute of Technology

Remote Sensing Laboratory,
Swedish University of Agricultural Sciences, Umeå

(Note: Several groups are engaged in research concerning remote sensing; only the largest and most active groups are listed here. Details on the activities are given in "Space Research in Sweden", published biannually for the COSPAR meetings.)

4.1 Satellites

Viking - Sweden's first satellite

Viking was launched from Kourou in February 1986. The mission ended in May 1987.

The scientific objective of the Viking satellite was to study the ionospheric and magnetospheric phenomena at high geomagnetic latitudes in the altitude region up to about two Earth radii. Simultaneous measurements were made of electric and magnetic fields, particle distributions, plasma composition and waves as well as imaging in the ultraviolet of the aurora beneath.

The scientific results have been presented to the international community in symposia and conferences.

Freja - Sweden's second scientific satellite

Freja is a scientific satellite designed to carry instruments for research into the aurora and other magnetospheric/ionospheric phenomena. The low-cost satellite was launched on October 6, 1992, on the Chinese carrier Long March-2. The project has been carried out in cooperation with, inter alia, Germany.

The satellite weighs 214 kg in the final orbit, which ranges in altitude between 600 and 1 756 km. The inclination of the orbit is 63°. The scientific mission of Freja has many similarities with that of Viking. The auroral zone is the "mission target" and the satellite carries energetic particle detectors, magnetic and

electric wave experiments, electric field sensors and a UV imager. The Freja design provides a substantially higher data rate than that used on Viking.

Freja is operated from Esrange. Data are received at Esrange and at Prince Albert Satellite Station in Canada.

Odin - Sweden's next satellite

A combined astronomy and aeronomy satellite mission (Odin) is under study. Odin is a scientific satellite for spectroscopic studies at submillimetre wavelength of astronomical objects and processes in the Earth's atmosphere. The project will be carried out with international cooperation. The launch is planned for late 1997 with an operational lifetime of two years.

IMPACT (Investigation of Magnetospheric Particle Acceleration and Turbulence)

A proposed project is being studied in cooperation with Germany's Max Planck Institute for Aeronomy. Current plans envision launching IMPACT in 1998-1999.

Other Satellite Projects

The Institute of Space Physics in Kiruna and the Swedish Space Corporation have built experiments for measurements of mass and energy distribution for ions and electrons in the magnetosphere. One experiment is planned for launch within the Interball-concept.

The Institute of Space Physics in Kiruna will participate with hot plasma experiments (ASPERA) in the planned project Mars-94.

The Institute of Space Physics in Kiruna has participated in the development of a particle experiment for the ESA-satellite Ulysses. Both the Kiruna and the Uppsala departments of the Institute of Space Physics and the department of Plasma Physics of the Alfvén Laboratory, the Royal Institute of Technology in Stockholm, are involved in the Cluster project in the Solar Terrestrial Science Programme, the first cornerstone in ESA space science programme Horizon 2000.

The Stockholm Observatory and the Astronomical Institutes in Lund and Uppsala participate with several quest investigator programmes on the International Ultraviolet Explorer (IUE) satellite launched in January 1978 and still operating.

The Stockholm Observatory also takes an active part in the ESA Infrared Space Observatory (ISO) satellite project and is constructing an IR-camera (ISOCAM). Sweden also participates in the ESA's GIOTTO, HST and HIPPARCOS satellite projects.

4.2 Sounding Rockets and Balloons

Swedish sounding rocket and balloon launches have been carried out since 1962 and since 1968 from Esrange. Most of these have been and continue to be international cooperative projects.

The Swedish sounding rocket and balloon programme is focused on four main areas:

- magnetosphere and ionosphere physics
- upper atmosphere physics and chemistry

- astrophysical infrared and sub-millimetre studies
- material and fluid and bio-science in microgravity

The Swedish Space Corporation is responsible for the technical execution of the projects as well as for the operation of Esrange.

The Swedish Materials Science Experiment Rockets (MASER) programme, which started in 1987, offers one launch per year for experiments within the fields of material physics, fluid-science and bio-science.

For projects requiring an apogee of 800-1000 km, an Attitude Control System in addition to the S19 boost guidance system is necessary to decrease impact dispersion. The development and testing of a Spinning rocket attitude control system (SPINRAC) has been accomplished.

There is an increasing interest in microgravity experiments of long duration. The long-duration sounding rocket (LDSR) programme, named MAXUS, is carried out jointly by Germany and Sweden and it is based on a required payload weight of 750 kg and 14-15 minutes of microgravity. The first successful MAXUS launch took place at Esrange in 1992. The next launch is planned for 1995.

4.3 Ground based experiments

Sweden is participating in the work of the European Incoherent Scatter Facility (EISCAT) Scientific Association. The association has installed a multistatic incoherent scatter facility in the auroral zone, comprising a system of stations at Tromsø (Norway), Kiruna (Sweden) and Sodankylä (Finland).

5. ESRANGE

Esrange is a Swedish space research range situated in northern Sweden, close to the town of Kiruna at a latitude of about 68°N. The base is managed by the Swedish Space Corporation.

Space research activities are carried out at Esrange in international cooperation using ground based instrumentation, sounding rockets, balloons and satellites. Due to the geographical location of the base, studies of the aurora and other high latitude phenomena are of particular interest.

The possibility for land recovery makes Esrange very suitable for all sounding rocket experiments needing recovery, for instance microgravity research.

Esrange has the capacity to launch most types of sounding rockets including high performance vehicles. The range also has significant experience with releasing scientific balloons.

The Esrange sounding rocket and balloon activities are performed as an ESA Special Project. Contributing ESA members can use the range on a marginal cost basis. Non-ESA members are also welcome to use the facilities.

Esrange is also used in various satellite projects. A number of ground facilities for the support of national and international spacecraft programmes are in operation or under development. The majority of the passages of polar orbiting satellites are inside the coverage zone of the Esrange satellite ground stations.

A facility for the reception, recording, archiving, processing and dissemination of remote sensing satellite data was established at Esrange in 1978. The station was originally used for spacecraft in the Landsat series and operated within the framework of ESA's Earthnet programme. The station has been extended to accommodate the SPOT satellites. A separate ESA facility, the Salmijärvi satellite ground

receiving station, dedicated for the European Remote Sensing Satellite (ERS-l) and other future satellites has been established.

A Tracking, Telemetry and Control (TT&C) station is used to support polar satellites during the launch phase and when in service in their nominal orbits. The station includes a dedicated Operations Centre and a display and analysis facility for scientific data.

The Ground Control Station for Tele-X is located at Esrange.

6. OTHER SPACE-RELATED FACILITIES AND INSTALLATIONS INCLUDING TELEMETRY AND ACQUISITION

A subsidiary to the Swedish Space Corporation, the SSC Satellitbild, is situated in Kiruna. Its main tasks are to process, analyses and distribute images from the SPOT and Landsat satellites on a commercial basis.

The Onsala Space Observatory, located on Sweden's west coast, operates radiotelescopes, chiefly for radioastronomical observations. The newest telescope has a radome-enclosed 20 m diameter reflector with very high surface accuracy for work at millimetre wavelengths.

A joint Scandinavian Intelsat earth station is located at Tanum on the west coast of Sweden.

A joint Scandinavian earth station for the European Communication Satellite System (ECS) is located near Stockholm.

A number of HRPT and APT weather picture receiving stations are also in operation.

7. INTERNATIONAL COOPERATION

Within ESA Sweden participates in the mandatory basic and scientific programmes, in the ARIANE launcher project as well as in the projects for future space transportation systems, in the COLUMBUS programme, the telecommunications programmes, the remote sensing programmes and finally the microgravity programme. Bilateral scientific cooperation between Sweden and the United States is carried out under an agreement with NASA.

Similar scientific cooperation is carried out with the Russian Federation.

Bilateral cooperation on space science and applications is carried out between Sweden and France under an agreement with Centre National d'Etudes Spatiales (CNES).

Germany and Sweden have concluded Memoranda of Understanding on, inter alia, scientific cooperation in the Freja Project and in the field of hypersonic technologies/SÄNGER.

Memoranda of Understanding have been concluded as basis for cooperation with Austria, Canada, China and India. Other bilateral cooperative efforts are carried out on ad hoc basis.

Sweden is a member of INTELSAT, EUTELSAT, INMARSAT and EUMETSAT.

8. OTHER ACTIVITIES

8.1 Courses

Sweden has broad experience with remote sensing and Geographical Information Systems (GIS) at governmental agencies, universities and companies.

This experience and know-how can be made available to developing countries where there is need for mapping and other forms of remote sensing applications. There is thus an increasing demand for technology transfer in the form of training of personnel from developing countries.

For, inter alia, this purpose, a Swedish Institute for Geographical Information Technology (SIGIT) has been established in Kiruna. The institute, which is still operating in its initial phase, offers courses in practical application of remote sensing. The courses are based on the resources of, inter alia, university institutes, the SSC Satellitbild company and the Swedish Land Survey in the area. The aim is to meet high vocational demands of both national as well as international students and trainees in the field of remote sensing and geographic information technology.

Annual UN Training Courses on Remote Sensing Education for Educators started in Sweden in 1990 and are hosted by the Swedish Government. The courses are conducted jointly by the University in Stockholm (Dept. of Physical Geography) and the SSC Satellitbild.

8.2 Space Debris

Sweden does not conduct any national research on Space Debris, but supports the activities undertaken within ESA and in other fora.